

635.10	Concrete Bin Type Retaining Wall, Closed Face	square meter [Square Foot]
635.11	Concrete Bin Type Retaining Wall, Open Face	square meter [Square Foot]
635.12	Galvanized Metal Bin Type Retaining Wall	square meter [Square Foot]
635.13	Galvanized Metal Bin Type Retaining Wall with Fiber Coating	square meter [Square Foot]

SECTION 636 - MECHANICALLY STABILIZED EARTH RETAINING WALL

636.01 Description The work under this item shall consist of design, fabrication, furnishing, transportation, and erection of Mechanically Stabilized Earth (MSE) retaining wall system of the required type, including miscellaneous items necessary for a complete installation.

The MSE retaining walls shall consist of reinforcing strips or reinforcing mesh earth wall systems utilizing architectural precast concrete facing panels supported on cast-in-place concrete leveling pads. All reinforcing strips or mesh material shall consist of galvanized steel. The wall structures shall be dimensioned to achieve the design criteria shown on the plans and specified herein.

The MSE retaining walls shall be constructed in accordance with these specifications and in conformity with the lines, grades, design criteria, and dimensions shown on the plans or established by the Geotechnical Engineer.

636.02 Quality Assurance The MSE retaining wall system shall be one of the approved wall systems noted in the Contract Documents. Alternate systems will not be considered. Value engineering is not applicable to the work of this Item.

All necessary materials, except backfill and cast in-place concrete shall be obtained from the approved system designer.

Mechanically Stabilized Earth (MSE) retaining walls shall be designed and

constructed as specified herein. The design shall be subject to review and acceptance by the Geotechnical Engineer. The acceptability of a MSE retaining wall design shall be at the sole discretion of the Geotechnical Engineer. Any additional design, construction, or other costs arising as a result of rejection of a retaining wall design by the Geotechnical Engineer shall be borne by the Contractor.

Precast facing panels shall be manufactured in a concrete products plant with approved facilities. Before proceeding with production, precast sample units shall be provided for the Geotechnical Engineer's acceptance. These samples shall be kept at the plant to be used for comparison purposes during production.

All calculations and Shop Drawings shall be signed and stamped by a Professional Engineer registered in the State of Maine and specializing in geotechnical construction.

The Contractor installing the MSE retaining walls shall have demonstrated experience constructing MSE walls and shall use personnel having demonstrated experience in the installation procedures recommended by the manufacturers and as specified herein.

Requirements for the precast facing panels are different from the standard panels from the approved systems. The Contractor shall prepare appropriate, alternate details.

All MSE walls shall be built in accordance with the plans and accepted shop drawings for the proposed wall systems.

A qualified representative from the wall design-supplier shall be present during construction of the MSE walls. The services of the qualified representative shall be at no additional cost to the project. The qualified experienced technical representative to advise the Contractor and the Engineer concerning proper installation procedures.

The vendor's representative shall specify the required back-batter so that the final position of the wall is vertical. Furthermore, footing berms shall be placed in front of the first 3 levels of panels erected, to maintain verticality.

636.03 Design Requirements The MSE retaining walls shall be designed to provide the grade separation shown on the plans with a service life of not less than 100 years.

In general, the MSE wall system shall be designed in accordance with the

manufacturer's requirements, as specified herein and shown on the plans, and in accordance with the Special Provisions. Where conflicting requirements occur, the more stringent requirement shall govern.

The MSE wall design shall follow the general dimensions of the wall envelope shown on the plans. Base of footing elevation shall be as shown on the plans, or may be lower. All wall elements shall be within the right-of-way limits shown on the plans. The panels shall be placed so as not to interfere with drainage or other utilities, or other potential obstructions.

All appurtenances behind in front of, under, mounted upon, or passing through the wall such as drainage structures, utilities, fences, concrete parapet wall or other appurtenances shown on the plans shall be accounted for in the stability design of the wall.

Facing panels shall have tongue and groove, ship lap or similar approved connections along all joints, both vertical and horizontal. The shape of the panels shall be such that adjacent panels will have continuous, vertical joints, or as noted on the plans.

MSE facing panels shall be installed on cast-in-place concrete leveling pads. The top of the leveling pad shall be located at or below the theoretical leveling pad elevation. The minimum wall embedment shall be 1.22 meters [4.0 ft] as measured to the top of the leveling pad, or as shown on the plans, whichever is greater. The top of the face panels shall be at or above the top of the panel elevation shown on the plans. Where coping or barrier are used, the wall face shall extend up into the coping or barrier a minimum of 50 mm [2 in].

The MSE walls shall be dimensioned so that the allowable bearing pressures, noted on the plans, are not exceeded. Requirements for over excavation of native foundation soils and replacement with compacted structural fill are detailed on the plans.

The design by the wall system supplier shall consider the stability of the wall as outlined below and in the Contract Documents:

(a) Failure Plane The theoretical failure plane within the reinforced soil mass shall be determined per the Special Provisions and be analyzed so that the soil stabilizing components extend sufficiently beyond the failure plane within the reinforced soil

mass, as determined by the specified design code, to stabilize the material. External loads which affect the internal stability such as those applied through piling, bridge footings, traffic, slope surcharge, hydrostatic, and seismic loads shall be accounted for in the design.

(b) MSE walls shall be designed to resist failure by overturning, sliding, instability of temporary construction slope, bearing capacity, reinforcement pullout, panel connection pullout or rupture. The design methodology shall be as noted in the Special Provisions.

Calculations for stresses and factors of safety shall be based upon assumed conditions at the end of the design life.

The actual applied bearing pressures under the MSE Mass for each reinforced length shall be clearly indicated on the design drawing.

Passive pressure in front of the wall mass shall be assumed to be zero for design purposes. Calculations for stresses and factors of safety shall be based on assumed conditions at the end of the design life.

(c) Backfill and Foundation Soils Parameters The friction angle of the select backfill used in the reinforced fill zone for the internal stability design of the wall shall be assumed to be 34° unless noted otherwise. The friction angle of the foundation soils and random backfill shall be assumed to be 30° unless otherwise shown on the plans.

(d) Reinforcement length The soil reinforcement shall be the same length from the bottom to the top of each wall section. The reinforcement length defining the width of the entire reinforced soil mass may vary with wall height. The minimum length of the soil reinforcement shall be 2.44 meters [8 ft], but shall not be less than $0.7 H$ for walls with level surcharges or $0.7 H_1$ for walls with a sloped surcharge or walls supporting an abutment. The mechanical height, H or H_1 , shall be the vertical difference between the leveling footing and the elevation at which the failure surface, as described above, intercepts the ground surface supported by the wall.

(e) Steel Reinforcement For steel reinforcements, all structural connections, tie strips and loop inserts, the following galvanization and carbon steel loss rates shall be assumed:

	microns/year/side
Zinc galvanizing (first 2 years)	15
Zinc galvanizing (subsequent years to depletion):	4
Carbon Steel (after galvanizing depletion):	12
Carbon Steel (75 to 100 years)	12

When the expected differential settlement normal to the wall exceeds 75 mm [3 in], the lower level reinforcement facing connections shall be designed to accommodate the increased tensile forces due to settlement.

(f) Facing Panel Requirements

1. The wall facing shall be designed to accommodate differential settlements of 305 mm [1.0 in] in 30.5 meters [100 ft].
2. The minimum spacing between adjacent panels shall be 19 mm [$\frac{3}{4}$ in] in order to accommodate differential settlements without impairing the appearance of the facing or compromising the structural integrity of the individual panels. Joints between panels shall be no more than 19 mm [$\frac{3}{4}$ in]. Joint between panels shall have a ship lap configuration or tongue and groove connection. There shall be no openings through the wall facing, except for utilities to pass through the wall. Slip joints to accommodate differential settlement shall be included where shown on the plans.
3. Where wall or wall sections intersect with an angle of 130° or less, a special vertical corner element panel shall be used. The corner element panel shall cover the joint of the panels that abut the corner and allow for independent movement of the abutting panels. Corner elements shall not be formed by connecting standard facing panels that abut the acute corner.

636.04 Materials The Contractor shall be responsible for the purchase or manufacture of the precast concrete facing panels, reinforcing mesh or strips, panel/reinforcement connections, bearing pads, joint filler, and all other necessary components. The Contractor shall furnish to the Geotechnical Engineer the appropriate Certificates of Compliance certifying that the applicable wall materials meet the requirements of the project specifications. All materials used in the construction of the

MSE retaining walls shall meet the requirements specified in the following subsections of the Maine Standard Specifications and as specified herein.

Materials not conforming to this section of the specifications, or from sources not listed in the contract documents, shall not be used without written consent from the Geotechnical Engineer.

636.041 Reinforced Concrete Facing Panels Reinforced concrete facing panels shall meet the requirements specified in the following subsections:

Structural Precast Concrete Units

712.061

636.0411 Precast Panel Tolerances and Surface Finish Concrete surface for the front face shall be as noted on the plans. The rear face shall have an unformed surface finish. The rear face of the panel shall be roughly screeded to eliminate open pockets of aggregate and surface distortions in excess of 6 mm [$\frac{1}{4}$ in]. All uncoated steel projecting from the panel unit shall be galvanized in accordance with AASHTO M111 (ASTM A123) with a minimum coating thickness of 610g/m² [2oz/ft²]

Precast panel tolerances shall comply with the following; units that do not meet the listed tolerances will be rejected.

1. Panel dimensions (edge to edge of concrete) within ± 5 mm [$\frac{3}{16}$ in].
2. Panel thickness: ± 6 mm [$\frac{1}{4}$ in].
3. Squareness. The length difference between the two diagonals shall not exceed 12 mm [$\frac{1}{2}$ in].
4. Distance between the centerline of dowel and dowel sleeve, and to centerline of reinforcing steel shall be ± 3 mm [\bullet in].
5. Face of panel to centerline of dowel and dowel sleeve, and to centerline of reinforcing steel shall be ± 3 mm [\bullet in].
6. Position of panel connection devices Tie Strip shall be ± 25 mm [1 in].
7. Location of Coil and loop Imbeds shall be ± 3 mm [\bullet in].
8. Warping of the exposed panel face shall not exceed 6 mm [$\frac{1}{4}$ in] in 1.52 meters [5 ft].
9. Surface defects on smooth-formed surfaces measured over a length of 1.52 meters

[5 ft] shall not exceed 3 mm [\bullet in]. Surface defects on textured-finished surfaces measured over a length of 1.52 meters [5 ft] shall not exceed 5 mm [5/16 in].

636.042 Reinforcing All reinforcing, tie strips, and attachment devices shall be carefully inspected to insure they are true to size and free from defects that may impair their strength and durability.

A. Reinforcing Mesh shall be shop fabricated from cold drawn steel wire conforming to the requirements of AASHTO M 32M/M 32 (ASTM A 82) yield strength minimum of 450 MPa [65 ksi] and shall be welded into the finished mesh fabric in accordance with AASHTO M 55M/M 55 (ASTM A 185). Galvanizing shall be in accordance with AASHTO M 111 (ASTM A 123) after fabrication. The minimum coating thickness shall be 610g/m² [2 oz/ ft²]. Any damage done to the mesh galvanization prior to the installation shall be repaired in an acceptable manner and provide a minimum galvanized coating of 610g/m² [2 oz/ ft²].

B. Reinforcing Strips shall be fabricated from hot rolled bars to the required shape and dimensions. Their physical and mechanical properties shall conform to ASTM A572/A 572M Grade 450 (65), or approved equal. Reinforcing strips shall be hot dipped galvanized in accordance with AASHTO M111 (ASTM A 123) after fabrication. The minimum galvanization coating thickness shall be 610g/m² [2 oz/ ft²]. Any damage done to the mesh galvanization prior to the installation shall be repaired 610g/m² [2 oz/ ft²].

C. Tie strips shall be fabricated of hot rolled steel conforming to ASTM A 570/A 570M Grade 345(50) or equivalent. Tie strips shall be hot dipped galvanized in accordance with AASHTO M111 (ASTM A 123) after fabrication. The minimum coating thickness shall be 610g/m² [2 oz/ ft²].

D. The tie strips and reinforcing strips shall be cut to lengths and tolerances shown on the submitted plans. Holes for bolts shall be punched in the locations shown.

636.043 Attachment Devices

A. Loop Embeds shall be fabricated of cold drawn steel wire conforming to ASTM A510M, UNS G 10350 or AASHTO M 32M/M32 (ASTM A82). Loop imbeds shall

be welded in accordance with AASHTO M 55M/M55 (ASTM A185). Both shall have electrodeposited coatings of zinc applied in accordance with ASTM B633.

B. Fasteners shall consist of hexagonal cap screw bolts and nuts, which are galvanized and conform to the requirements of AASHTO M164M (ASTM A325M) or equivalent.

C. Connector Pins and mat bars shall be fabricated from AASHTO M 183M/ M 183 (ASTM A 36/A 36M) steel and welded to the soil reinforcement mats as shown on the plans. Galvanization shall conform to AASHTO M111 (ASTM A123) with a minimum coating thickness of 610g/m^2 [2 oz/ ft²]. Connector bars shall be fabricated of cold drawn steel wire conforming to the requirements of ASTM A 82 (AASHTO M32) and galvanized in accordance with ASTM A 123.

D. Structural plate connectors and fasteners used for yokes to connect reinforcements to wall panels around pile or utility conflicts shall conform to the material requirements for reinforcing strips and fasteners in 636.042 (c).

636.044 Joint Materials Joint material shall be installed to the dimensions and thickness in accordance with the plans or approved shop drawings.

A. Provide flexible foam strips for filler for vertical joints between panels, and in horizontal joints where pads are used.

B. Provide either preformed EPDM rubber pads conforming to ASTM D2000 for 4AA, 812 rubbers or neoprene elastomeric pads having a Durometer Hardness of 55 ± 5 .

636.045 Nonwoven Drainage Geotextile The Cover all joints between panels on the back side of the wall with a geotextile fabric. Slit film and multifilament woven and resin bonded woven geotextile fabrics are not allowed for this application. The minimum width of the fabric shall be 300 mm [12 in]. Lap fabric at least 100 mm [4 in] where splices are required. Nonwoven Drainage Geotextile shall be bonded with an approved adhesive compound to the back face covering all joints between panels. Adhesives used to hold the geotextile filter fabric material to the rear of the facing panels prior to backfill placement shall be supplied by the wall supplier and approved by the Geotechnical Engineer.

636.046 Concrete Leveling Pad The cast-in-place leveling pad shall be constructed of Class B concrete conforming to the requirements of Section 502 - Structural Concrete. Leveling pad shall have minimum dimensions of 150 mm [6 in] thickness and 300 mm [12 in] width and be placed at the design elevation shown on the shop drawings within a 3 mm [$\frac{1}{8}$ in] tolerance.

636.049 Backfill Materials All backfill materials used in the MSE Walls volume shall conform to Gravel Borrow conforming to the requirements of Section 703.20, with the maximum aggregate size limited to 100 mm [4 in] and the following additional requirements:

A. Soundness The material shall be substantially free of shale or other soft, poor durability particles. The materials shall have a magnesium sulfate soundness loss, as determined by AASHTO T104 (ASTM C88), of less than 30% after four cycles.

B. Electrochemical Requirements The backfill materials shall meet the following criteria:

<u>Requirements</u>		<u>Test Methods</u>
Resistivity	>3,000 ohm centimeters	AASHTO T288
pH between	5 and 10, inclusive	AASHTO T289
Chlorides	<100 parts per million	AASHTO T291
Sulfates	<200 parts per million	AASHTO T290
Organic Content	<1%	AASHTO T267-86

C. The plasticity index (P.I.) as determined by AASHTO T90 shall not exceed 6.

D. The select backfill material shall exhibit an angle of internal friction of not less than 34° , as determined by the standard Direct Shear Test, AASHTO T236 (ASTM D3080-72), on the portion finer than the 2 mm [#10] sieve, compacted to 95 percent of AASHTO T99, Methods C or D (with oversized correction as outlined in Note 7) at optimum moisture content. No testing is required for backfills where 80 percent of sizes are greater than 19 mm [$\frac{3}{4}$ in]. Before construction begins, the borrow selected shall be subject to show conformance with this frictional requirement. Compliance with the test requirements shall be the responsibility of the Contractor, who shall furnish a copy of the backfill test results prior to construction.

636.050 Crushed Stone for Abutment Foundation Crushed stone for use in the

foundation layer below the abutment shall be crushed stone conforming to the requirements of Section 703.31.

636.051 Impervious Membrane An impervious geomembrane shall be installed near the top of the reinforced backfill to reduce the chance of water infiltrating into the reinforced backfill. The geomembrane shall be bonded to the inside face of the wall panels and extend perpendicularly from the wall face into the fill, while being parallel to the top of the wall. The membrane should be sloped to drain away from the facing and outlet beyond the reinforcing zone. The impervious geomembrane shall extend into the fill a distance of 0.3 m [1 ft] beyond the MSE reinforcement. The geomembrane shall have a minimum thickness of 0.8 mm [1/32 in].

The geomembrane shall have both sides textured with a rough finish to improve resistance against sliding. The texture shall be approved by the Geotechnical Engineer before installation. The geomembrane shall be shown on the design drawings of the MSE submittal of the Contractor.

636.052 Acceptance of Material The Contractor shall furnish to the Geotechnical Engineer a Certificate of Compliance certifying that the above materials comply with the applicable contract specifications including the backfill material, in accordance with Section 700. A copy of all test results performed by the Contractor necessary to assure contract compliance shall also be furnished to the Geotechnical Engineer. Acceptance will be based on the Certificate of Compliance, accompanying test reports, and visual inspection by the Geotechnical Engineer.

636.07 Submittals

A. Design computations demonstrating compliance with the criteria specified herein and shown on the plans, shall be prepared, signed and stamped by a registered professional engineer license in the State of Maine and specializing in geotechnical engineering.

The design calculations shall include:

1. Statement of all assumptions made and copies of all references used in the calculations.

2. Analyses demonstrating compliance with all applicable earth, water, surcharges, seismic, or other loads, as specified herein and required by AASHTO.

3. Analyses or studies demonstrating durability and corrosion resistance of retaining wall systems for the proposed location and environment. The designers shall provide all corrosion protection devices necessary for the retaining wall to have a minimum service life of 100 years in the proposed location and environment.

B. A detailed resume of the wall designer listing similar projects with references, and demonstrating necessary experience to perform the MSE retaining wall design, including a brief description of each project that is similar in scope.

C. A detailed listing of MSE walls that the Contractor has constructed including a brief description of each project and a listing of personnel who will construct the walls demonstrating their experience in construction of MSE retaining walls. A reference shall be included for each project listed. As a minimum, the reference shall include an individual's name, address and current phone number.

D. Manufacturer's product data for the MSE wall system, including material, manufacture and erection specifications, all specified erection equipment necessary, details of buried MSE wall elements, special details required of reinforcing layout around drainage structures and sign foundations, structures design properties, type of backfill and details for connections between facing panels.

E. Details of precast yard and concrete mix design.

F. Shop drawing showing the configuration and all details, dimensions, quantities and cross sections necessary to construct the MSE wall, including but not limited to the following:

1. A plan view of the wall, which shall include Contract limits, stations and offsets, and the face of wall line shown on the plans.

2. An elevation view of the wall which shall include the elevation at the top of the wall at all horizontal and vertical break points and at least every 15 meters [50 ft] along the face of the wall, all steps in the leveling pads, the designation as to the type of retaining wall system(s), and an indication of the final ground line and maximum calculated bearing pressures. The face of wall shown on the plans shall

be indicated.

3. A typical cross section or cross sections showing the elevation relationship between existing ground conditions and proposed grades, and the proposed wall configuration, including details for the proposed methods for connecting to existing conditions. The sections shall also indicate the location of the face of wall shown on the plans.

4. General notes pertaining to design criteria and wall construction.

5. A listing of the summary of material quantities for each wall.

6. Details of sleeves and pipes and other embedded items to be installed through the walls.

7. Clearly indicated details for construction of walls or reinforcing elements around drainage, foundations, utilities or any other potential obstructions.

8. Details of the architectural treatment of facing panels.

9. Drainage design detail and design scheme.

10. Location of utilities.

11. Sequence and schedule of construction, including overall construction schedule.

12. Methods of excavation and backfill.

13. Method of maintaining stability of excavated trenches.

14. Method of monitoring plumbness and deviation of wall.

15. Excavation support system, if any.

16. Any acceptance testing and frequency.

17. Details and location of all necessary construction and expansion joints along the wall.

18. Connection details at the interface of the wall and any adjacent proposed cast in place retaining wall or abutment structure.

19. Details of impermeable membrane connection to abutment in roadway runoff collection system.

636.08 Delivery, Storage and Handling

A. Contractor shall check the material upon delivery to assure that the proper material has been received. A product certification should be provided with each shipment.

B. Material shall be stored above -29° C [-20° F]

C. Contractor shall prevent excessive mud, wet cement, epoxy and like substances that may affix themselves to the material from coming in contact with the material.

D. Material may be laid flat and stored outside for 30 days. For extended storage, material shall be stored in or beneath a trailer or covered with a colored tarpaulin to prevent long-term exposure.

636.09 Wall Excavation The excavation and use as fill disposal of all excavated material shall meet the requirements of Section 203 - Excavation and Embankment, except as modified herein.

636.10 Foundation Preparation The foundation for the structure shall be graded level for a width equal to the length of reinforcement elements plus 1.52 meters [5 ft] or as shown on the plans. Prior to wall construction the foundation shall be compacted with at least 10 passes of a smooth wheel vibratory roller weighing at least 4536 kg [5 ton]. Any foundation soils found to be unsuitable or incapable of sustaining the required compaction shall be removed and replaced with special borrow material. The foundation for the structure shall be approved by the Geotechnical Engineer before erection is started.

A concrete leveling pad shall be constructed as indicated on the submitted plans. The leveling pad shall be cast to the design elevations as shown on the plans. Allowable elevation tolerances are +3mm [0.01 ft] and -6 mm [-0.02 ft] from the design elevations. Placement of wall panels may begin after 24 hours curing time of the concrete leveling pad.

636.11 Wall Erection A field representative from the proprietary wall system being used shall be available, as needed, during the erection of the wall. The services of the representative shall be at no additional cost to the project.

Precast concrete panels shall be placed so that their final position is vertical or battered as shown on the plans. The vendor representative shall specify the required back-batter so that the final position of the wall is vertical. Earth berms at the footing shall be placed to maintain the desired position of panels. For erection, panels are handled by means of lifting devices connected to the upper edge of the panel. Panels should be placed in successive horizontal lifts in the sequence shown on the approved shop drawings as backfill placement proceeds. As backfill material is placed behind the panels, the panels shall be maintained in position by means of temporary wedges or bracing according to the wall supplier's recommendations.

Concrete facing vertical tolerances and horizontal alignment tolerances shall not exceed 6 mm per meter [$\frac{1}{4}$ in/yd]. During construction, the maximum allowable offset in any panel joint shall be 19 mm [$\frac{3}{4}$ in]. The overall vertical tolerance of the wall (for top to bottom) shall not exceed 4 mm per meter of wall height.

636.12 Backfill Placement Backfill shall not be placed between November 1st and April 1st. Backfill placement shall closely follow erection of each course of panels. Backfill shall be placed and compacted in such a manner as to avoid any damage or disturbance of the wall materials or misalignment of the facing panels or reinforcing element. Any wall materials, which become damaged during backfill placement, shall be removed and replaced at the Contractor's expense. The Contractor, at their expense, shall correct any misalignment or distortion of the wall facing panels due to placement of backfill outside the limits of this specification. Prior to the placement of the soil reinforcement, the backfill elevation after compaction shall be at the required elevation of the reinforcements. At each reinforcement level, the backfill shall be placed to the level of the connection. Backfill placement methods near the panels shall assure that no voids exist directly beneath the reinforcing element.

Gravel borrow backfill shall be compacted in accordance with Subsection 203.12 except that the minimum required compaction shall be 95 percent of maximum density as determined by AASHTO T99, Method C or D (with oversize correction, as outlined in Note 7. If 30 percent or more of the backfill material is greater than 19 mm [$\frac{3}{4}$ in] in size, the acceptance criterion for control of compaction shall be either a minimum of 70 percent of the relative density of the material as determined by ASTM D4253 and D4254, or a method of compaction consisting of at least 4 passes by a heavy roller. Where spread pads support bridge or other structural loads, the top 1.5 m [5.0 ft] below the pad elevation shall be compacted to 100 percent of the maximum density as determined by AASHTO T99, Method C or D (with oversize correction, as outlined in Note 7).

The moisture content (determined in accordance with AASHTO T99, Method C or D) of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. Backfill materials shall have a placement moisture content less than or equal to the optimum moisture content. Backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift.

At each reinforcing level, backfill shall be leveled before placing and bolting the reinforcing. The maximum lift thickness after compaction shall not exceed 300 mm [12 in]. The Contractor shall decrease this lift thickness, if necessary, to obtain the specified density.

Heavy compaction equipment shall not be used to compact backfill within 900 mm [3 ft] of the wall face. Compaction within 900 mm [3.0 ft] of the back face of the wall shall be achieved by at least 3 passes of lightweight mechanical tamper, lightweight roller, or vibratory system. The specified lift thickness shall be adjusted as warranted by the type of compaction equipment actually used. No vehicular equipment shall be operated within 1.0 meter [3.28 ft] of the panels.

The frequency of sampling of the backfill material necessary to assure gradation control throughout construction shall be as directed by the Geotechnical Engineer.

At the end of each day's operation, the Contractor shall slope the least level of the backfill away from the wall facing to rapidly direct runoff away from the wall face. In addition, the Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

636.13 Reinforcement Placement Prior to placing the first layer of reinforcements (strips, mats or grids), backfill shall be placed and compacted in accordance with 636.12 - Backfill Placement.

Bending of reinforcements in the horizontal plane that results in a permanent deformation in their alignment shall not be allowed. Gradual bending in the vertical direction that does not result in permanent deformations is allowable.

Cutting of longitudinal or transverse reinforcement bars to avoid conflicts with utility obstructions or piles will not be allowed. A structural connection (yokes) from the wall panel to the reinforcement shall be used whenever it is necessary to avoid cutting or excessive skewing of reinforcement due to pile or utility conflicts.

Soil reinforcements shall be placed normal to the face of the wall, unless otherwise shown on the plans or directed by the Engineer. If skewing of the soil reinforcements is required due to obstructions in the reinforced fill, rotatable bolted connections shall be used and the maximum skew angle shall not exceed 15° from the normal position except

in the case of acute corner where redundant reinforcements are used. The tensile capacity of splayed reinforcement shall be reduced by the cosine of the splay angle.

636.14 Method of Measurement Mechanically Stabilized Earth Retaining Wall will be measured by the square meter [square foot] of face area computed using the plan dimensions. No adjustment in the pay quantity will be made if the computed quantity, based on the working drawings, varies from the plan quantity.

Vertical dimension limits will be from the top of leveling pad to the top of the wall facing units, as shown on the plans. The horizontal dimension limits will be from the edges of the facing units at each end of a wall, as shown on the plans. No field measurements will be made unless the Resident specifies, in writing, a change to the limits indicated on the plans.

The wall surface area, as shown on the plans, includes the surface area of nominal panel joint openings and wall penetrations such as pipes and other utilities.

636.15 Basis of Payment The accepted quantity of Mechanically Stabilized Earth Retaining Wall will be paid for at the contract unit price per square meter [square foot]. Payment shall be full compensation for design, fabrication and erection of MSE retaining walls, furnishing all labor, equipment and materials including concrete face panels, fasteners, reinforcing mesh, reinforcing strips, tie strips, hardware, joint fillers, coping, woven drainage geotextile, impervious membrane, select backfill and technical field representative. Cost of cast-in-place concrete for leveling pad will not be paid for separately, but will be considered incidental to the Mechanically Stabilized Earth Retaining Wall.

Excavation, including extra excavation due to unsuitable foundation material, will be measured and paid for under Item 203.20 - Common Excavation. Foundation material and select backfill material will be considered incidental to the Mechanically Stabilized Earth Retaining Walls.

The unit price for Mechanically Stabilized Earth Wall shall include costs for:

1. All design work, preparation of written submittals and plans, revision of submittals, sample submittals and any other necessary preliminary work prior to and after acceptance of the retaining wall by the Geotechnical Engineer.

2. All materials, including transportation, for the MSE walls, including facing panels, MSE reinforcing elements, attachment devices, fasteners, bearing blocks and shims, joint materials, copings, vertical corner elements, concrete masonry, reinforcing steel, crushed stone, select backfill and incidentals.

3. All labor and equipment required to excavate and prepare the wall foundation, form and cast the leveling pad, erect the MSE wall to the lines and grades shown on the plans, place and compact backfill, place and compact the drainage layer, and construct any other items necessary to complete the MSE wall.

4. All temporary sheeting, temporary excavation, and temporary dewatering necessary to perform the other work in this section.

There will be no allowance for excavating and backfilling for the Mechanically Stabilized Earth Retaining Wall beyond the limits shown on the approved submitted plans, except for excavation required to remove unsuitable subsoil in preparation for the foundation.

Payment will be made under:

Pay Item

Pay Unit

636.40 Mechanically Stabilized Earth Retaining Wall
[square foot]

Square meter

SECTION 637 - DUST CONTROL

637.01 Description This work shall consist of controlling dust that results from traffic on the project and the Contractor's operations by applying water and/or calcium chloride as directed by the Resident. In addition to this Special Provision, the requirements of Special Provision 656 and the pertinent Sections of the Standard Specifications will apply.

637.02 Materials The water shall not be salt or brackish and shall be free from oil, acid and injurious alkali or vegetable matter.